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Featuring

Traffic Control Engineering

Summer Camp Sanitation

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Volume XVI FEBRUARY, 1929 Number 2

TRAFFIC CONTROL ENGINEERING

By Miller McClintock*

(Presented before the Boston Society of Civil Engineers, December 19, 1928)

There is probably no field of professional activity developing so rapidly as is engineering. The very great increase in the complexity of modern life, and especially in technical methods for accomplishing new results, has brought many new opportunities to the engineer during the last quarter of a century. Those who were connected with engineering practice twenty-five years ago see today the inclusion of many subjects which were never formerly contemplated as engineering problems. In no aspect are the complicated elements which come under the engineers' jurisdiction changing more rapidly than in American cities. The problem of street traffic is just one of many of the rapidly shifting conditions in current urban life. It is another instance of the important public problems which arise and need the kind of attention which engineers have been trained to give to problems of this character.

I am not going to give a technical talk tonight, or a formal one. I am going to think more or less out loud, and to tell something of the experiences I have been having the past few years, with the hope that I can give some idea of the breadth of the problem and of its character, and that this may stimulate questions from you later on.

In the first place I would like to outline to you just a little bit what the traffic problem is, because while you are in the midst of it constantly it is very difficult to vizualize its influence on social life unless you have really studied it. The problem of traffic as illustrated in the streets and highways of American cities is the problem of unbalanced supply and demand, or of too great pressure in a carrying system which we have at present. We must operate arteries of travel over the street and highway systems which we have, and this is a problem, particularly in the case of such highways as have expanded very rapidly during the last few years, but which are connected with streets where the expansion has been slow.

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The street system in the central part of Boston is practically identical with that laid down one hundred years ago; in many parts with that of one hundred and fifty or two hundred years ago. It was originally designed for the needs and requirements of community necessities for travel of a small colony, using a very different type of transportation than we find it necessary to use today. We have built up on that very inadequate street system a tremendous metropolitan system, similar in size to many large cities throughout the country, and then we attempt to pour through it hundreds of thousands of people where only ten or a score or so were intended to move in the first place, and also to move them by very special type of transportation.

This is not a particularly new problem in American cities or in the city of Boston. I suppose one of the most acute traffic situations in this city was in the 90's, when traction lines were operating on Tremont and Washington streets. As some one very aptly wrote, "We have changed the quiet streets of the city of Boston into a situation of chaos where quiet streets no longer prevail and where electric monsters crush out human lives . . .," etc. Those electric monsters have disappeared underground, which has been a temporary traffic salvation, but in the past quarter of a century the old methods of travel, particularly by means of mass transportation, have changed. We have added a torrential flood of motor vehicles. I know of nothing so striking in the change of physical habits as the manner in which the American people have adopted, absorbed and utilized motor power. We are accustomed to hearing this past quarter of a century referred to as the age of the development of flight. We might with equal reason refer to it as the age of development in the use of the motor vehicle. It was only a quarter of a century ago that it came to stay. In that short period of time not only has the motor car developed to the efficiency of the greatest mechanical refinement, but it has been so rapidly reduced as to price of production that practically every one can own one. Almost every student of mine has at least a Ford, and I know that out in Los Angeles at least, Fords can be picked up for $25, for $15, and cars that will run, all the way down to $5. Every citizen can own a car, and they do in increasing numbers.

This last year in the United States showed a registration of about 24,000,000 automobiles — twenty-three and a half million, to be exact. Thirty years ago there were none. There are only 29,000,000 cars in use in the entire world. We have approximately 24,000,000 of them in the United States. This has changed all the transportation systems and has brought with it a problem of a very weighty character. I should like to indicate very briefly some complexities of the traffic problem as found in the typical American city.

In the first place there is the definitely social problem of automobile accidents. There were killed in the United States last year, in automobile accidents, 27,000 persons, and about 700,500 persons suffered serious personal injuries in automobile accidents. This is in excess of 1½ per cent of the entire population, to say nothing of the tremendous capital and financial loss sustained through automobile accidents. The social problem is, therefore, one of the greatest importance, and a very definite problem in connection with traffic control throughout the country. It is being met by various agencies, but unfortunately few seem to be able to make much impression on this particular part of the problem.

The second part is the economic factor, and this also is a very serious one. The cost of living and the cost of commodities depend to a very great extent upon local transportation charges. The cost of trucking within cities may amount to as much as 150 per cent of the total external transportation charges. It may cost one and one-half times as much to bring the product to the ultimate consumer as it does to bring it from its place of production to the city. Transportation has also an effect on the location of mercantile concerns. This matter of location is dependent to a very large degree on traffic congestion. It causes what we call the decentralization phenomenon, or the tendency for business to move outward. People in Boston have seen the very rapid and spectacular growth of the Park Square district, for instance. Only a few years ago there were very small and unimportant buildings located there. Today it has become an important retail center, with large buildings. This is an evidence of the tendency of business to grow outward whenever the accessibility of the location is hampered in any way. Every merchant appreciates the importance of accessibility to his business. If his store is inaccessible or traffic congests in front of his door, his accessibility results in loss of sales. People who cannot reach him will seek other markets. It is that tendency which induced Sears Roebuck to build out in the Fenway.

These are some of the aspects of this problem; some of the reasons why the agencies in American cities, interested in business, have bestirred themselves to take very definite and direct means of dealing with the problem of traffic accidents and traffic congestion.

I should like to tell you something about the development of the technique for handling this situation and of some of the relief measures that are being used by American cities at the present time. I want to speak first briefly about city planning and regional planning in relation to traffic relief. The traffic problem is largely the problem of too great pressure; too great demand for existing facilities, therefore since the street and highway systems are inadequate the natural relief would seem to be to build additional facilities. That is a perfectly logical answer. It is limited, however, by how far a city is justified in going in spending the necessary money. Boston, for instance, has been hesitant to build the proposed so-called "intermediate highway" for passing travel around the central and southern part of the city to the North Station area. Obviously the cities are not at an end of their traffic problems. What we see today is the indication of even greater problems to come tomorrow. For the motor car, both as the carrier of people and for trucking, is so useful it is evident that its use will grow. So therefore any city which fails to grasp the opportunity for traffic relief by establishing better facilities, widening the existing arteries, extending its arteries, extending new streets, through construction of traffic relief measures such as the East Boston Tunnel, is, of course, missing an opportunity which, though very costly, might easily be paid for out of the losses which accrue each year. It is difficult to give an exact figure of the losses resulting from traffic congestion. I was talking with the president of the Yellow Cab Company in Chicago a year or so ago, and he said: "Don't you think too much money is being spent on traffic relief?" I said that depended on whether it was wasting as much as the money expended in relieving the situation. He said that seemed to him doubtful. I asked: "How many trips do your cabs make into the loop district?" He told me. I said: "Suppose each cab saves a minute or suppose it loses a minute; how much time would that aggregate?" So he figured out the total number of minutes involved in the operation of his 3,800 cabs, and the number of trips. I said: "How much gasoline do they use when idle?" He figured this out, and it came to one gallon every forty minutes, and at the wholesale rate he was then paying we found that one minute's delay on the 3,800 cabs making trips into the center of the city had a value of something over $100,000 in one year. That indicates how much money may be involved. In Boston one could figure up a tremendous loss which any statistician would recognize as perfectly logical to be laid to the traffic problem. So a great expenditure of money may readily be justified to bring even normal or local relief.

I am not going to talk about the proposed city planning projects of Boston. I do want to emphasize, however, one particular type of relief and particular principle of plan which seem to me most critical and important at the present time in the congested portions of our cities. You realize that so long as we have the operation of vehicles on conflicting routes on the same grade we will not get great speed. If you take Commonwealth Avenue and even widen it to twice its present width Massachusetts Avenue and other crossings, such as at Cottage Farm Bridge, will always seriously limit the activity of the arterial passes to 50 or to 30 per cent of its possible capacity. If you assume two highways meeting at grade, each one with a demand for its full capacity, and then conceive of the traffic control devices necessary to take care of alternating it fifty-fifty for each road, you will see that under the most efficient conditions the capacity of each road would be reduced to 50 per cent. Actually the capacity is reduced to 35 or 30 per cent, because in starting and stopping there is additional lost motion and lost time. It becomes quite apparent in the more congested cities, such as Boston, Chicago, New York, Philadelphia and Detroit, that we must turn to a new principle of plan in street construction if we are to use the automobile to its full capacity and speed up traffic conditions.

Whenever a city has reached a population of approximately 1,000,000 it has been found necessary to take the traction facilities and develop rapid transit by elevated structures or by subways. You can no longer operate on the surface because of interference. The same thing is apparent in the case of the major truck lines, and rapid transit highways are being developed with grade separation so that at no point will there be the necessity of limiting the capacity of the routes through interference of cross traffic. We would have thought that idea very futuristic only a few years ago. Now we have come to regard it as inevitable. You may be interested to know that already it has passed the phase of the theoretical. It is actually being applied. Manhattan has just made an appropriation for the construction of an elevated highway along the Hudson River, with the ultimate plan of extending it all the way to Riverside Drive. Chicago has two examples of the superhighways. It is the only city I know of where one can approach within half or quarter of a mile of the business district at an average speed of forty miles an hour. This is by outer drives along Lake Michigan. They have been constructed with grade separation, without interference of any kind. So you can come into the city at forty miles an hour without the necessity of delay because of traffic control. I think that the planning feature of the future American city, so far as the trunk lines are concerned, will be the construction of elevated streets carrying traffic without grade interference and with country highway speeds. The Bureau is now conducting a study of about half Chicago's area — the Cook County area — to find out if the elevated highways going to the north and northwest would be justified. We are going about it as an engineer would go about the location of a new bridge. We are trying to find the most strategic place to locate it, etc.

But I do want to get to my particular phase of the traffic problem, — the part in which the Erskine Bureau is especially interested. About seven years ago a far-sighted student of public administration saw in the city streets a problem of great importance in the future. Seven years are not a very long time, and yet when I undertook for Professor Monro research for traffic conditions, I was able to find only two articles worthy of being catalogued as serious studies of managing traffic in city streets. Today it is difficult to pick up any technical magazine without discovering something on traffic. In that short time it has come to be a very pressing and critical public problem. When we started to study it we found in American cities a situation more or less to be expected. It was a new problem and its seriousness and future importance had not been realized. It was being dealt with as a purely political problem. Officers were assigned, right and left turns prohibited, etc. The American city ordinances were a great hodge-podge of political and city regulations, as you can imagine.

The first thing we discovered was that it was not a problem to be dealt with by the agencies attempting to handle it. It was an engineering problem, capable of being studied and analyzed and solved and regulated like any other important engineering problem. So we started on that basis and attempted to erect very primitive standards and records which would justify our presenting to American cities a claim that they should establish technical agencies to deal with this problem, then of importance and which would be of much greater importance in the future. The typical American city still regulates its practice of prestige and the influence of politicians. This is typical but not universal. This study has now developed into a substantial system, and many American cities have begun to study traffic problems as serious engineering problems. In the last three years there have been established in fourteen American cities traffic engineering divisions. They have established agencies for studying accidents, the causes of accidents, the physical factors involved, congestion conditions, and also are following up the limitations now applied to see whether they bring the required results. Fourteen American cities have such agencies functioning in them, rendering service similar to that given by the water engineers in connection with the water supply, and the planning engineers in connection with city planning.

The most significant development in traffic engineering that has taken place in any American city has recently taken place under Mr. William Williams of the Department of Public Works, in the creation of the Traffic Engineering Division in the Commonwealth. The act of the Legislature empowering the Department of Public Works to assume very wide control and jurisdiction over traffic affairs of the entire Commonwealth is of significance. This is the first time that an American Commonwealth has recognized officially, through its Legislature, that the problem of traffic control and vehicular control by statutes and controlling devices is one that takes serious engineering attention, and is a problem to be determined and worked out on the basis of engineering ability and knowledge. It is largely through Commissioner Williams that this act was passed, and his sympathy and earnest endeavor have furthered progress in the solution of the problem in Massachusetts.

More and more city planning agencies are coming to rely upon this technique which is being developed in determining the method in which facilities should be used. Sometimes the most elaborate facilities are not warranted in order to take care of it. I have in mind the Whacker Drive situation. The construction of this drive cost $22,000,000. We watched the construction with considerable interest, and noted two or three places where the combined congestion of traffic was too great. It was designed for horse-driven vehicles. Though it was built with a double deck and wide, it does not work at all. Traffic control devices were installed and rendered it highly efficient, with the exception of two or three portions which will have to be entirely reconstructed.

This, in brief, is the development of traffic engineering, and I shall be very glad to answer questions about it if you care to ask them. It does present in a rather tentative and embryonic form the new opportunity for engineering skill and science offered by this traffic problem. We are depending largely on the young engineers to develop new things, and they are developing them. This is illustrated by the construction and operation of automatic traffic signals. Five years ago there were no automatic systems. Today we have the choice of half a dozen signals. The city of Boston will introduce a very comprehensive system of co-ordinate signals in the near future. Only fourteen cities employ traffic officers for control purposes. It will not be more than a decade, I believe, before every city of 25,000 or over will have a traffic engineer and every State highway department will be similarly equipped. And to a similar degree in the operation of large fleets of trucks there will be at their heads those capable of ordering traffic operation. This offers an opportunity to the young engineer in a new field.

Discussion

MR. M. N. HALSEY: * Dr. McClintock has covered the general phases of traffic engineering, and I merely hope to call attention to what the State is attempting to do. American cities have invariably grown up at the intersections of important crossroads; and it is to these points of congestion that the traffic engineer has heretofore been attracted. Recently, however, modern developments in the automobile have made possible inter-city trips of great length. This transition from intra-city to inter-city travel has greatly increased the importance of State supervision. State-wide traffic control has become necessary. One of the methods of establishing this control is to call together a regional conference in an endeavor to induce the people in charge of traffic to get together on basic principles. Another is by direct legislation. Chapter 357 of the Acts of 1928 of the Commonwealth of Massachusetts has provided us with this method. This law gives the State supervisory authority over all traffic signs, signals and through streets. Under this supervision we are going to bring about gradually a uniformity of basic regulations. The law also sets forth the possibility of a standard organization to carry on this uniformity and to keep in touch with the times.

The first thing to do is to develop a background, to take an inventory. We have issued to every city and town in the Commonwealth a questionnaire. With the returns from these and from personal observation in the field, together with the results of national studies, we

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* Traffic Engineer, State Department of Public Works.

hope to form a State code to be placed in the hands of cities and towns. Then when any city is about to erect a signal system or to adopt traffic control measures, it can look at the code and ascertain the requirements which should be fulfilled.

Recently the Department has issued Bulletin No. 1 on the subject of "Through Streets." This gives the type of signals to be used on through streets, and tells under what conditions they have been found successful and under what conditions unsuccessful. Bulletin No. 2 will cover "Stop and Go Signals." Another bulletin will be devoted to signs. Supplementary to these will be furnished a State code. The Department is also undertaking an accident analysis for the purpose of determining the effects of types of pavement, lighting, curves, painted lines, etc.

The work of the Department to date has met with fine response. Everywhere its representatives have been received and accepted pleasantly. The cities and towns seem to feel a great interest in what is being done. In the few instances where cities or towns have erected signals illegally, it has been found to be due to lack of information. The questionnaires have also aroused great interest. The officials in Worcester, for instance, wanted to know how well their work compared with that of Springfield and Lynn.

I think the State of Massachusetts is taking a very advanced step here, and I believe that, when this movement is in full swing, the State will be in a very fine position from the point of view of control as well as that of uniformity. It certainly has a fine network of highways on which to work. I think Massachusetts has taken the lead in this particular type of movement, and I believe that other States will soon follow her example.

MR. WILLIAM F. WILLIAMS:[*] I want to say first that I am more than glad to see that the regulation of vehicular traffic as a problem has at last got where it belongs, and that is in the hands of engineers. When I first approached the subject in an effort to find a solution of the problem of traffic regulation I was told that it was a police matter, and I saw at once that it would take some time to overcome the then prevailing notion that the entire problem was wrapped up in the execution of rules or regulations, rather than in their formulation. No thought seemed at that time to have been given to the creation of rules, regulations and devices. That is where the engineer belongs.

Seven years ago the Legislature created a special commission to study the traffic situation throughout the State, and I tried to induce that commission to recognize as a fundamental principle of the problem that it should be worked out by men used to dealing with the constructive side of large problems; the enforcement of regulation was another matter, that might well be the policeman's job. But I was unable to make my views sink in very deep. I said at that time that the Department of Public Works was the natural agency to handle this question, although the work would require a special organization that should be headed by a traffic engineer. Now that this point has been recognized I hope that our civil engineers will see its value and will give it more of their time and consideration.

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[*] Commissioner of Public Works, 413 State House, Boston, Mass.

Mr. McClintock is to be congratulated upon having had the foresight and courage to step into this new and undeveloped field, and to have shown wherein it belonged to the engineer, and for having worked out such wonderful results from the application of his energies and faculties.

In regard to my connection with the act recently passed by the Legislature for uniform traffic regulation, I do not want to take too much credit to myself for the law, because I think it was largely due to the logic of the situation. There were various discussions as to how the matter should be handled. There was a strong tendency on the part of several gentlemen who had taken an interest in the subject to create a new department to handle the situation. That is always the first thought of many men in approaching these new subjects. For some reason or other there is a disinclination to accept the machinery that you have, and a feeling that it gives the subject greater importance if it is placed in charge of a new organization.

There were quite a good many studying the problem. The Governor had created a special Safety Commission to find a way to stop the terrible loss of life on the highways and streets of the State. This commission devoted considerable time to the proposed legislation, and as discussion proceeded I think they saw the futility of trying to combine departments or of creating another department. As I have already stated, the logic of the situation suggested the Department of Public Works as the proper medium for executing the directions of the Legislature.

This Department already had very broad powers under existing legislation with respect to highways. It only needed a very little more authority to enable it to evolve a uniform system for the regulation of traffic throughout the Commonwealth.

It was evident, also, that in order to be an effective agency in the control of traffic, the regulations must be founded on some simple fundamental system that could be applied to every municipality, whether a small town or a large city. In other words, traffic regulation must be based upon a common language that can be easily learned and as easily understood, so that when a citizen of Newburyport finds himself in Pittsfield the signals directing him through the streets will be exactly the same as the signals in his own city. Just why that idea should have taken so long to develop and impress its importance upon people generally, I do not know.

I think it must have been all of five years ago that I first suggested to a committee of the Legislature that in the use of lights for the regulation of traffic we should accept the system already adopted and used many years by the steam railroads; that is, that green should always indicate "safety," yellow "caution," and red should always be "stop". You will recall that we used green lights on dummy policemen all over the State without any regard to whether they meant safety or danger. It took some time for this simple rule to sink in, but it has, although you will still find throughout the State a very indiscriminate use of these colors, which I hope will be stopped by the rules to be eventually promulgated by the Department.

Incidentally, I might remark that I do not believe in any turns on red. Green is the light on which you should go. That applies not only to the movement of traffic but also to the pedestrian, as we have something else besides the automobile to consider in this problem. The pedestrian has got to have some show for his life. If you read the weekly motor vehicle accident returns you will notice that a large majority of the fatalities are pedestrians. Sometimes almost two-thirds of those killed are pedestrians. This is a terrible record; in fact, it is an awful indictment of a people who think they are the most advanced and civilized of all the people on the face of the earth.

The automobile for some reason or other has created a tremendous desire for haste. That is primarily the cause of many of these accidents; but just what all our people do with this time that they save with the automobile nobody has yet discovered. I suggest to my engineering brethren that it would be an interesting subject for them to study.

There is, however, a human side to the question of traffic control which requires that we shall not lose sight of the accidents occurring almost daily through the operation of the motor vehicle, which neither I nor Dr. McClintock believes will be eliminated by the establishment of a uniform code or the adoption of standard signals. That part of the problem is much deeper than regulation, and its solution lies in the hands of the individual operator.

I presume that we must have at the close of this year about 800,000 motor vehicles registered to operate on the highways of Massachusetts. The actual certificates of registration for 1928 will total nearly 900,000, but under our system there are duplications of registrations, so that the certificates issued do not indicate that that number of vehicles were licensed to operate. The actual number was something less than 800,000. We will call it in round numbers 800,000.

Every vehicle has to have an operator, never mind how many passengers there may be. That represents 800,000 operators, which is about one-fifth of the population of the State. This number also agrees approximately with the number of persons who are licensed to operate motor vehicles in Massachusetts. Here are 800,000 individual units which cannot be compared with the personnel of any other means of transportation. An engineer, a fireman, a conductor and two or three brakemen will operate a train with possibly 100 freight cars, moving a great many tons of goods. A still smaller crew will operate the largest passenger train. These trains are also operated on steel rails in a fixed right of way, and yet it takes years for a man to become an engineer on any train operated on rails. I would not hazard a guess as to just how long it takes a person to become an operator of a motor vehicle, but I know it is a very short time, and yet when it comes to speed there is no question but what the motor vehicle can meet the speed of any train operated in this country, and if you should offer sufficient inducement and release the operator from arrest I do not doubt but there are many who will gladly undertake to exceed the speed of the fastest train.

How to reach and control the mind of the operator is the problem. Of course, uniform rules, regulations and traffic regulating devices will be a great help, but I regret to say they will be observed consistently and fully only by those operators who are naturally cautious and law-abiding. The reckless, careless operator follows no rule and observes no direction, and in my opinion this class will pay no more attention to the proposed regulations than he does to the things that he can see without even being told that they should be seen. Bear in mind that no cautionary sign can tell anything that you cannot see if you use your own eyes intelligently.

In addition to the motor vehicles registered in Massachusetts we have at times in certain localities fully 50 per cent additional traffic in the shape of visiting cars. During the summer months visiting cars throughout the State will average about 25 per cent of the total traffic. In Berkshire County at the height of the tourist season it will amount to 50 per cent. On the Cape it is nearly as high at times. Under the courtesy provision of the law visiting cars are free to come and go as they see fit for thirty days, and many of them run even longer. I do not think they seriously affect the character of the problem, but they certainly add to the difficulties of its solution. However, it still remains an engineering problem, and I hope the engineers of our municipalities and those in private practice will give it all the attention they can spare.

I would like to have Dr. McClintock say a word as to how closely he thinks our study and the probable code eventually to be promulgated by the Department will fit into the National Code on uniform traffic rules.

Mr. McClintock: I am very glad to talk about that, because it gives me an opportunity to say something about the national movement, which reached a head more or less last year. In 1924 Mr. Hoover called a national conference to consider the problem of highway safety, and to work out plans for the control of traffic so far as street vehicles were concerned. After about two years' work a uniform vehicular code was drawn up, with a standard uniform method of registration of vehicles, licensing of drivers, and a very comprehensive section on the regulation of vehicles so far as general rules of the road are concerned — "Keep to the right," etc. It was a very advanced code, and fifteen States have adopted it at the present time. It is anticipated that during the present legislative session many more States will bring their vehicular codes into conformity with it. Massachusetts, so far as registration of drivers is concerned, is in advance. It is more conservative in some of the other regulations than are the Middle West and western States.

Secretary Hoover requested from all over the country from public agencies in American cities having to do with traffic copies of their ordinances applicable to this subject.

In 1926 he called a second conference, to consider a uniform ordinance. This conference worked about two years, and last spring it turned out a uniform ordinance. It is a simple document, basic in character, general in principle, and therefore to a very considerable degree applicable to cities and to States wherever they may be and whatever their peculiar characteristics may be.

But it soon became apparent that these two documents were not adequate. They were, after all, only legal documents, and all the people had not time to read them or the ability to understand them, no matter how simple they appeared to be. They were very simple laws, but it was surprising how a motorist could establish a very good alibi on the ground that he could not understand. It became apparent that there must be some uniformity also in the methods of promulgating these codes on highways where they were to be applied. So the American Engineering Council appointed a special committee to draw up a standard code of signs and signals conforming to the highway signs. It has just completed its work, and that uniform code on signs and signals is now being run off on the press.

So there are now three national documents, none adequate in itself for complete and full application. The procedure under Mr. Williams' supervision, under the Department of Public Works, has been to apply so far as possible these uniform standards. We have always kept an eye definitely on the national uniform code, so Massachusetts has been the first State to apply it generally.

In the first place the standard of highway signs comes under Mr. Delano's supervision. Such application of municipal signs should conform to such a degree with those already established as the highway standard that they will not cause any great change in design from the existing signs, and also from the existing signs in other cities and towns. So it was necessary to take these three things into consideration; they must conform to Massachusetts' peculiar conditions, as existing in Massachusetts' cities. Los Angeles, for instance, has nice straight streets with other streets crossing at right angles. There are only two diagonal streets in Los Angeles. Here in Boston very few are parallel, so it represents a very special problem. However, if Connecticut or New Hampshire should adopt the Massachusetts code intact, the average motorist going from one State to another would not be conscious of any very great changes.

MR. LEWIS E. MOORE:* It is interesting to wander around the country and see how different ideas regarding traffic control are working out in different places. Massachusetts has only one through highway specially designated, but several towns have signs stuck up and other through ways marked. I wonder exactly how legal these other signs are. Washington, D. C., has gone so far on through streets that I think all of the avenues are through routes. When driving through it becomes necessary to stop about every other block because of the great number of through streets. Through streets are a good thing, but in Washington are carried too far.

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MR. MCCLINTOCK: I know of no other study in the United States, except in Chicago, where account is being taken of the distance factors involved, of the origination and the destination of the traffic. In other words, we will know what the routes are serving for the average vehicles or the individual vehicles from the various districts, and whether the total saving will justify the expenditure. In addition to the saving in life and limb there is also the saving constituted by delays at intersections. For instance, take the intersection of the approach to the Massachusetts Avenue bridge in the parkway on the other side of the Basin, — an intersection with which you are all familiar. There are a certain number of minutes of time lost there. Of course we may not use these minutes profitably when we get home, and yet a good many use them profitably. Then they represent a great loss in gasoline. It is very easy to study the traffic at that intersection and determine the total amount of delay and then capitalize the monetary value. It would be a good thing to put a subway under that Massachusetts Avenue approach.

QUESTION: In your opinion grade separation would not be justified in Boston?

MR. MCCLINTOCK: I think there are very many places, particularly on the metropolitan system in Boston, where it would be justified, especially in view of the traffic during the summer months. I think it is a control method which is going to be recognized much more fully. Very little study has been given to it as yet.

QUESTION: Is there any data on which to base the economical width of a highway, especially in cities that control separation of traffic by the semaphore?

MR. MCCLINTOCK: Some studies have been made by the Bureau of Roads of the Department of Agriculture. While I cannot give precisely their results you will find them in the study of the roads in Cleveland. They divided the roads into one-foot widths and gave a number to each strip, and then studied the pattern of traffic by the strips passed through by the rear right wheel. On that basis they determine the pattern of traffic for roadways of different widths. There is a tendency on narrow roadways, 30 or 40 feet, for uneconomical use, because there is only one line of traffic going in each direction. A third line cannot squeeze in. The rest is waste, and a pattern such as I have mentioned will reveal this waste. There is also a fair presumption that roadways of excessive width, such as 100 feet, as have been constructed in Detroit and misnamed superhighways, are uneconomical also. They really are not "superhighways" because they are being blocked by cross traffic, and consequently cannot carry their capacity. You very rarely see two vehicles which are travelling in the same direction remain abreast. They overtake and pass one another, — and this should always be at the right, — but the great portion of these wide roadways do not carry the travel they should, even in congested periods. I have always been very skeptical of roadways in excess of 80 feet. There have been no adequate studies to give the efficiency of roadways such as Commonwealth Avenue, with a parkway through the middle. I think, though, this is a very fine type of construction. In New Orleans you will find a great many neutral ground streets. There are parkways in the center, for the drainage there has to be pumped, and the drains are run down through these neutral areas. This forms a very efficient way of separating traffic.

One gets the same result from the two type roadways, several of which have been developed in the vicinity of Boston. One is on the Providence road, and another on Mr. Ford's roadway past the Wayside Inn. This has a bituminous strip down the center, with concrete on either side. The concrete attracts traffic and logically separates it.

Mr. Frank O. Whitney:* In regard to signals or signs which may be adopted, in passing through cities, for instance, going from Boston to Portland, we arrive at Salem, for example. We find our way into Salem and are guided quite clearly how to get out at the north. Similarly at Newburyport and at Portsmouth, and at Biddeford in Maine. The question I want to ask is whether in these studies which have been made on the traffic in Boston any way has been discovered by which the stranger can receive guidance on entering the city as to how to get out on the other side. That is to say, can he be told the nearest way he can get from the south side to the north side? I have heard a great deal of criticism of Boston thoroughfares and the absence of any marking which would guide the stranger in this respect. Undoubtedly, the stranger passing through Boston would prefer to pass around on the edge of the city, rather than go through the congested business district. At present any one ignorant of the streets might feel he could best find his way across the city by keeping to the water front, and going around Atlantic Avenue and getting out after passing the North Station. I wonder whether any way has been found for directing the stranger in this connection.

Mr. McClintock: I might answer that from personal experience.

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I have been living here now almost a decade, and I still get lost in the North End or down the other side of Washington Street. Often when I think I am going parallel to Washington Street I find myself at the South Station. I have to ask some kind Bostonian to direct me. And, have you noticed, if you do this, he will almost invariably answer that he cannot *tell* you but that he will *show* you. This at first impresses you as extremely courteous. But it is not courtesy. It is inability to explain so complex a thing as the Boston street system.

The major routes through Boston are marked, and it is being attempted to keep them adequately marked and in line with new developments. The motorist from the south is now directed over the Northern Artery, instead of over the old route through Somerville. The difficulty is to keep the signs visible, with all the competition they now have. I would rather go from the South Shore to the North Shore than attempt to go from Cambridge to Roxbury.

We found a very interesting thing during our traffic study of the city of Boston. We made a unique study of the origin and destination of motor traffic. We had twenty police officers assigned to this by the commissioner, to stop people and ask them where they were from and where they were going. Of course this was terribly annoying to some people who had something illegal along with them. And then there were others who thought they were going to be apprehended for something. So it was a great relief to them to discover they were only going to be asked the route they were taking and where they were from. Note was also made as to where they were when the question was put to them. So we got a great deal of data on the vehicles moving through the city. It was amazing to discover how uninformed the average Bostonian was as to the most direct route for him to take from one point to another. On Charles Street, for instance, 17 per cent of the vehicles had no origin or destination in that district. They were just following what they knew as the most obvious way, and were jamming up the street with unnecessary traffic. They just did not know any better route to take. They had become accustomed to coming into town and then going out that way, and so when there was no need to come into town they followed that same route because they happened to know it.

We recommended a system of intra-city routes so that the people in Cambridge could reach Roxbury without going by devious ways.

I think your point, Mr. Whitney, was very well taken. Mr. Delano worked on this problem, not only as to routing on the highways, but carrying people through the cities in such a way as to cause themselves and others as little delay as possible.

QUESTION: I think the system adopted in Milwaukee takes care of that last question. They have what is marked as Arterial Highway 15, for instance. All you have to do is to look at the road map and know where you want to go, and then you are all set and do not have to inquire.

QUESTION: I would like to ask Mr. McClintock's idea as to the advisability of constructing streets at right angles. He mentioned that Los Angeles had but few diagonal streets.

MR. MCCLINTOCK: It greatly simplifies the control problem. Perhaps the best division of control methods might be between cities in which the streets are natural and those in which they are artificial. Boston streets are natural. It started out as a small settlement, and then Cambridge and Charlestown, etc., were added. It became necessary for people to come through to the center of Boston to transact business and sell their commodities, so they treked across the prairies and the swamps — that is what Washington Street was originally.

Boston is really a hub, because there are streets radiating out in practically every direction. There is no regular pattern to its routes. The street system formed itself in accordance with the community's needs, and consequently this plan is a perfectly natural one. Even though the cows did trace the pattern they usually knew the shortest way home. So these natural streets were laid down in the old trails people used to follow. Finally they were paved up and built, and various groups of planners came along and laid down the nice regular streets in the Back Bay district. That is a very regular sort of plan. But from the standpoint of controlling traffic cross streets are best. Take, for instance, in contrast Governor Square, where six or seven streets come in on important traffic arteries. This forms a very complex problem, because the surrounding streets are specialized streets, with restrictions — Audubon Road, for instance, Charlesgate East and Charlesgate West. Then Commonwealth Avenue is sacred park property, and you cannot operate a truck over it. Governor Square would be a comparatively simple problem in itself, but it has all these restrictions surrounding it. The simpler the street plan the easier the problem. I prefer this natural plan, which takes you by the most direct route possible.

At a simple control intersection the standard method of regulating traffic is by lights, such as Mr. Williams has described. Green means "Go" — straight ahead or turn to the left or the right. Unless there is a sign there is no left turn or no right turn. I wish there were no need for any green turning arrows at all. But the arrow does become useful if you are going south and you come to Boylston Street, which seems a regular intersection. It is a very irregular intersection so far as traffic is concerned, in the proportion of the movement from Tremont into Boylston Street or from Boylston Street into Tremont. It sometimes becomes necessary to indicate a right turn and let the Boylston Street traffic run. You cannot get that Boylston Street traffic through unless you stop the through movement along Tremont Street. So they throw on the red light, which stops traffic, and then show a green arrow, which modifies traffic so far as it relates to turning to the right.

It is regrettable that we ever have to use these green arrows; but many intersections are so complicated that it is necessary to use them. The new system covering Tremont and Washington streets will provide for a good many left and right arrows. There is also the necessity for serving the pedestrian movement across streets. There is a pedestrian interval in each cycle, when the pedestrian is given the exclusive use of the intersection.

QUESTION. In connection with the separation of grades, is there any case in Chicago at all comparable with the situation at Massachusetts and Commonwealth avenues?

MR. MCCLINTOCK: In practically every system there is something not unlike that.

QUESTION: I mean with respect to the possibility of grade separation?

MR. MCCLINTOCK: East Jefferson and Grand Boulevard in Chicago are quite similar. It cost about $350,000 there for grade separation. That was an unnecessarily large amount. It would be a simple matter to take a ramp down a subway under Massachusetts Avenue and a ramp up again were it not for one thing. Take the outbound traffic. There is no interruption at all. Never any delay, because the traffic east and west presumably goes right across. In fact it does not, for this reason. The traffic bound for Harvard Bridge along Massachusetts Avenue cannot go because you have to take traffic across it at Beacon Street. So grade separation at Massachusetts Avenue and Commonwealth would be just a waste of money. Outbound traffic would have no delay at Massachusetts Avenue but would get twice the delay at Governor Square and Cottage Farm bridge. Beyond Cottage Farm bridge you could distribute traffic and so not get the cumulative jam. It is the same thing at Charles River bridge and at Longfellow bridge. You can create grade separation there. You have a wide parkway and can put a subway down. Cottage Farm bridge will never be used to more than a fraction of its capacity. You have a differential in grade now between the approach to Cottage Farm Bridge and the elevation of the switch tracks of the Boston & Albany Railroad. If that elevation were carried along it would very greatly facilitate the approach to the bridge. Then you can take care of the other bridges, as I believe is being done in the plans for the other side of the river.

QUESTION: In connection with this wave system of traffic which is going to be used in Boston, what is to be done after the congested hours, when the traffic is not so heavy? How are you going to educate your drivers not to speed up over the average rate of speed?

MR. MCCLINTOCK: Perhaps I ought to explain the principle of automatic control. When automatic signals were first installed along Fifth Avenue — that was one of the earliest examples in the United States — all the lights were shown simultaneously red and simultaneously green. This was a very insular practice, but New York having installed the system did not like to change it. The result is they are still doing it. That type of control, where a whole avenue is tied up for its full length by the red light, or where the whole avenue is running its traffic with green lights on, is called synchronous or simultaneous co-ordination. In order to overcome the obvious difficulties of that system there are always a series of stop periods. No matter how fast the motor car is going he cannot cover the whole distance on one green light interval. People have tried to do it. That is the inefficiency of that system. Now it is done progressively. Instead of green lights on all the way each one controls a series of intersections along the street at certain known intervals, with a signal located at each intersection, and these signals are operated on a time sequence conforming to the speed of the cars, so that a vehicle after passing a green signal will reach the next signal just as it has turned from red to green, and so on up the street, and if it holds the uniform average speed, conforming to the time interval of the signals, can pass the entire length of the street without pause. Meanwhile the signals behind him are showing red and giving to the intersecting streets their opportunities for making crossings.

So, assuming all these factors mentioned, it has not been easy to work out a system for Boston. I do not mean that this progressive method of control will give any greater capacity of vehicles. You must have thirty-second intervals for the convenience of cross traffic. However, the effect on the efficiency of the system in control of traffic is tremendous.

On Michigan Avenue they have installed a system of synchronous control, and you can go from the Michigan Avenue bridge to the Grand Central Station with about three stops, at an average rate of speed of 11 miles an hour. We have designed for that street length a system of progressive control which will make possible the covering of that distance by vehicles at an average speed of 18 miles an hour. For the average driver the time has been increased about double. This has been done by changing the length of the cycle, that is, the time between the turning on of the green light, through the red light to amber, and back to the beginning of the green. This now takes 80 seconds. This speed is changed by changing the total time cycle, increasing or decreasing it. This is governed by how fast traffic, under the conditions of density which exist, can and will go. It is not like vaudeville, where one act is at "20 miles an hour" and the next at "15 miles an hour." We know in Boston how that speed varies on Washington Street. From 5 miles an hour to 20 miles an hour, according to the density of traffic. It gives an opportunity to the vehicle to go as fast as the vehicle would naturally go.

QUESTION: At night there is almost no traffic on Washington Street and comparatively little on Tremont Street. Suppose a man found he had the street to himself and no one ahead, would he be expected to regard the red signal?

MR. MCCLINTOCK: When I said we set the signals for "Go," I was not referring to the fellow who would want to go at 40 miles an hour up Washington Street. That is the sort of fellow I would be glad to see stopped by a stone wall or anything.

SUMMER CAMP SANITATION

By Elmer W. Campbell*

(Presented before the Sanitary Section, Boston Society of Civil Engineers, October 3, 1928)

The sanitation of summer camps is a problem which has been with us for a number of years but on which very little work has been performed by the health authorities until the last decade. Previous to the coming of the automobile the general public traveled very little over the highways excepting for short distances, and most of their stops were made at regular places of public entertainment, such as hotels and inns. The universal use of automobiles has altered these conditions to such an extent that now many families are apt to start out at the beginning of the summer season and travel from one end of the country to the other, stopping wherever fancy may dictate, either camping out at regular camping grounds or possibly in any open spot that may be available. To accommodate this vast hoard of campers thousands of cabins have been erected and tenting grounds opened up by private individuals and frequently by municipalities.

Another type of camps which has been increasing with great rapidity throughout the country is known as recreational camps, which includes sporting camps, boys', girls' and family camps, and which are often conducted very much like an open-air school, combining educational facilities with the benefits of outdoor camping. The necessity for proper sanitation of these various kinds of camps has been impressed on the health authorities in direct proportion to the increase in the number of camps.

In many States the legislative bodies have passed rules and regulations or laws governing the sanitary arrangements in the various kinds of camps. In Maine the last Legislature passed a law requiring that all recreational camps, overnight camps, roadside lodging and eating places must secure a license from the State Department of Health in order to carry on their business. The regulations pertaining to public eating places must be observed in order that a license may be secured.

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The types of camps which are today causing us a great deal of concern, and which need very careful supervision as to sanitary arrangements, are the vacation camps, especially those conducted for boys and girls, and the automobile camps.

Too great care cannot be exercised in disease-prevention measures when one considers that there are within the State of Maine alone one hundred and eighty-one boys' and girls' camps, accommodating thousands of children, whom we hope will be greatly benefited by their stay in the camps and will return home healthy and strong, carrying no possible infection to the schools or their home communities.

In 1881 the first camp to be established for boys was started in New Hampshire, and from that humble beginning has developed one of the great summer industries in some of our northern States. Of course, there are numbers of camps in other States of the Union and in Canada, but not in the proportion that they exist in the northern States. The first camp was crude and the boys lived "next to Nature."

The reception of the idea of summer camps by educators and schoolmen was very slow at first. Although slow it was progressive, and finally the idea of the summer camp for boys spread to those interested in the advancement of boys' work, and soon other camps were established. These camps have been largely maintained for healthful recreation, but there are many camps among them where tutoring is done.

The benefit of the boys' camps was recognized several years before girls' camps were established. Dr. and Mrs. Luther M. Gulick, in 1888, had a camp in Connecticut for their own daughters, and from this grew an idea for summer camps for girls, and in 1910 they established the Luther Gulick camps in Maine.

The real start for girls' camps was in 1902, although something had been done previous to this. The first camp for girls in Maine was the Cobbs Camps, established in 1902.

That the camps should have been located in New England on some of our loveliest lakes is only natural, and these were started in camping places that had long been favorite haunts. Until within a short time 90 per cent of all camps were in New England, but now they extend from the Atlantic to the Pacific and from Canada to the Gulf, yet the camps in New England outnumber the camps of all the rest of the country. Since the war the number of camps has rapidly increased, perhaps influenced by the benefit which our soldier boys received in our war camps.

Besides the camps operated and owned by private individuals, many organizations, such as the Y. M. C. A., Y. W. C. A., Girl and Boy Scouts, Church, Red Cross, Salvation Army, Boys' and Girls' Club, and many others have established camps.

As a result of the increase in camps which has naturally made competition to obtain campers, the grade of camps has gradually increased, until at the present time there are millions of dollars invested in this enterprise, and millions of dollars are spent by the campers each year.

The camp investment alone in the State of Maine is estimated at about $5,000,000, and about $10,000 a day is paid to the farmers of the State during the camping season for milk, butter, eggs, vegetables, etc., besides other money spent by the individual campers and their visitors.

Camp sites have been selected with reference to scenery, bathing facilities, water supply and food supply. Many were built where the only available route to them was by water, or the only easy route by this means. The character of the soil did not enter the consideration of the first camps built as they were small and very crude. It is now recognized that several things enter into the maintaining of a successful camp.

Parents send their children to camp for several reasons; the principal ones are that they may live out of doors to obtain or maintain strong vigorous bodies to endure the strain of study incident to the winter months at school; that they may obtain knowledge of woodcraft, athletics, boating, swimming and other things which build up a strong vigorous body and mind.

These campers come from every part of the United States, so that when they arrive in our respective States we ought to be sure that they are free from communicable diseases, which means that they should all be examined before leaving home. We ought to be as sure when they leave for home that they are as free as when they came. It certainly would hurt our States immeasurably if children, after returning home from their summer spent in our camps, should develop typhoid fever or other diseases, or should have these diseases in large numbers during the summer.

As these camps have increased in number and the numbers of the campers have increased it has been demonstrated that the best milk and purest water should be available, and that the disposal of garbage, refuse and sewage is a most important problem. As these camps are mostly located on the shores of lakes, rivers and streams (a few being on seashores), many of which are tributaries of water supplies, or are actually the water supply of cities and towns, this question of sewerage and sewage disposal is all important. We must protect the water supplies of our cities and towns.

One type of camp where little or no attention has been made to improve sanitary arrangements is the construction or logging camp, which is the pioneer camp and is often the forerunner of the people. The construction or logging camp is located far in the wilderness, for the purpose of bringing out raw materials to be used in industry. The class of laborers in these camps is not, as a rule, of particular interest to the general public, and formerly very little was done towards their health and comfort. In fact, very little was done to improve sanitary conditions at these camps until epidemics of typhoid fever or smallpox brought them to the attention of the health authorities, and the danger of polluting the public water supplies of cities and towns was discovered. Most logging camps were constructed on the shores of lakes, streams and rivers which later became sources of water supplies of cities and towns, and in some cases epidemics of typhoid fever were directly traceable to cases of this disease in these camps.

When sickness came which was traceable to these camps then people began to realize that they were not independent workers, but that there was always a certain relationship with all workers and the people in general.

Camp sanitation must include every sanitary arrangement for the comfort of the camper and all arrangements for the prevention of disease. Camps must be protected from mosquitoes, especially at night, not that mosquitoes are a direct danger to health in the northern States but they certainly are a great inconvenience and a nuisance. Besides the protection offered by screening the sleeper, the important thing is to destroy the breeding places for these insects.

Flies are a nuisance and a danger to health. They are spreaders of disease and a danger to the community. Flies are not tolerated, and if found are an indication that there is some unsanitary condition existing not far away. Many a camp owner has said, "We never have any flies here," yet there are many flies about when looking for them.

The important things to be considered in a camp of any size are that the water supply is safe, and abundant to take care of the camp needs at any time, even in the dryest seasons, and that the chances of polluting the source of the water supply are reduced to a minimum.

Brooks and lakes in our State are not recommended as sources of water supplies as there is always opportunity for pollution from careless or irresponsible people, which in some cases have resulted in serious illness.

It must be known that the milk supply is from accredited tested herds of cattle, and handled in clean dairies in a sanitary manner and that there is a proper disposal of garbage and sewage.

The upper few inches of soil is the home of countless millions of bacteria. These bacteria in the natural state are not generally productive of disease in man, although there may be bacteria in soil which if introduced into wounds will cause tetanus, malignant œdema, anthrax, etc., sometimes staphylococci and streptococci. Because the soil in its natural state is practically free from disease-producing organisms, it is only after man has appeared and polluted it with his careless habits that it is dangerous to health.

The trail of man is marked, and well marked, by tin cans, scraps of paper, remnants of wasted food, garbage, ugly camp sites, fecal deposits, flies and other disgusting reminders of civilization. Primitive man must move his camp at frequent intervals to avoid his own filth and allow nature to clean up after him. Civilized man rapidly soils his vacation camp sites in spite of laws, forest rangers, notices, pleadings, and especially the cleansing action of nature for nine months in the year. The soil is capable of taking care of large quantities of organic matter, but when it is well burdened it remains polluted, and then becomes a danger to health.

It is not only the amount of pollution but the kind of pollution and also the manner of disposal which play a very important part, and may endanger health by polluting drinking water or endanger life in other ways.

The soil of the field is called dirt when it gets on our hands or into our houses, and becomes a potential danger when it becomes polluted with human excretia or soil bacteria associated with wound infections. To the sanitarian dirt includes the soil polluted with manure, rubbish and organic wastes of all kinds. It may be the vehicle, but not the source of infection. We know that typhoid fever or other infections do not originate in dirt, but that it favors conditions which spread diseases, that may be deposited in the dirt.

Flies and other insects, known carriers of infection, breed in filth, live in it and spread the infection which may happen to be deposited in it.

Rosenaw says that "Cleanliness is the heart and soul of sanitation. We are inclined to place it even before godliness, for cleanliness of body, cleanliness of mind and soul, and cleanliness of our surroundings are essential to a full appreciation of the spiritual virtues."

When we consider that these boys and girls in our camps are the pride and comfort of their parents, and the future parents of other generations, it certainly is no small matter to look after them. Camp owners and directors assume heavy responsibilities when they take charge of these people, to look after their moral, mental, spiritual and physical welfare. The conditions of life are completely changed from their home environment. The important function of summer camps is to return the boys and girls to their homes with improved health, physique and in a better mental condition.

With several thousands of boys and girls in these camps in New England it behooves us to see that they are protected against disease in every way, by proper water and milk supply, proper food properly prepared, that the disposal of sewage and garbage is all properly looked after, and that the bathing beaches are properly protected against pollution, and that the bathing load is not exceeded.

A camp site should be selected not only as to good water supply but also with respect to good drainage and good surroundings. The character of the soil is very important. Clay makes a bad soil for camps, as it does not afford proper absorption of moisture, and if the season is a rainy one it is particularly disadvantageous. This kind of soil does not afford proper drainage for the disposition of sewage, no matter what system is used.

Camps should be carefully laid out, so that there is no chance that the sewage may contaminate the water supply and the bathing beaches. They should not be built too much in the shade, so that the sunlight will not have a chance to thoroughly dry the ground after rains or in foggy, damp weather.

After the camp is selected and the type of housing selected, it should be built as simply as possible, so that it can be kept clean easily, with proper light and ventilation and properly screened. The kitchen and dining rooms should be as far as possible, for convenience sake, from the toilets.

In Maine the health problems of the summer camp are those of the ordinary home many times increased, as many of these camps have between 50 and 150 campers. Camps need every safeguard that every home should have, and as the camp owner or director is in charge, he is *loco parentis* and is directly responsible. The campers must share with each other all the sanitary arrangements of the camp and should be considerate of each other.

As one would not from choice select a low marshy spot or a place surrounded by wet moist ground for his home, so such sites should not be selected for camps, especially when they are to accommodate a large number of people. Wet marshy places are breeding places for mosquitoes. Water-soaked soil is not favorable for camps as it does not permit of proper drainage, as the water level is very near the surface. For this reason of drainage, clay soil is to be avoided as far as possible.

When it is considered that the summer camp is built for the purpose of keeping the campers out of doors, weather permitting, the camp and all surroundings should be dry and well drained.

As this fact is well recognized the construction of camps should be given careful consideration for ventilation at all times, day and night, and in all kinds of weather, with proper protection for the sleeper from winds and rain, at the same time giving good ventilation. When camps were first instituted tents were the usual means of housing, but now more and more huts or buildings of the bungalow style are being used. There are several styles used, most of which are very satisfactory. The most satisfactory are those which accommodate only a small number, not over four or five campers with a councillor. The larger buildings for sleeping quarters are to be condemned, especially as to the dangers of spreading communicable disease. If only a small number are exposed the control is much easier. This has been demonstrated time and time again, and in many cases the disease has been kept confined to the inmates of one house.

The kitchen is the most important room in the camp from the point of view of health. No one will contradict the statement that the places where foods are prepared and stored should be the most sanitary places in the camp. In the modern hotel today every known device for cleanliness in the kitchen is installed, and as the camp is in reality a hotel given to the taking care of children only, the same care and supervision should be given to the kitchen as in a hotel, and it should be so situated that it has plenty of sunlight. There should be plenty of room, so that cluttering can be avoided.

Care should be taken in the selection of the kitchen help. Often the kitchen employee is mentally and instinctively lacking in appreciation of the niceties necessary in the handling of foods, and often herself a carrier of diseases.

Our State regulations require that all food handlers should be examined to show that they are free from communicable diseases, either in an active stage or as carriers. All cooks should be carefully questioned as to what diseases they have had, especially typhoid fever.

Dirty sink, food trays, dishes, benches and floors attract insects, especially flies, which may come from neighboring stables, from garbage containers, privies and toilets.

The ice box should be kept at a temperature of 50°. Many people wrap ice in some material to prevent it melting, ignoring the fact that the cooling of the refrigerator depends on the melting of the ice. This saves ice, but does not refrigerate properly, and causes people to wonder why milk soured while in the ice box. Many foods absorb odors, milk and butter being especially susceptible.

The dining room should be light, well ventilated and thoroughly screened in the preparation for the meals, especially if food is put on the tables before campers arrive. It should not be allowed that flies may wander over the food at this time. Food should not be exposed to insects any more here than in the kitchen.

Our regulations require that liquids stored for drinking purposes shall not come in contact with ice in such containers, and water coolers must contain two compartments, one for the ice and the other for drinking water. The common drinking cup is not allowed in this State. Even if none of the people have typhoid, Riggs disease, venereal disease, diphtheria or other diseases, common colds are too easily spread to allow the use of the common drinking cup.

Garbage disposal and refuse disposal are demanded by the generally accepted standards of cleanliness and convenience. The accumulation of waste foodstuff materials commonly called garbage may allow for the development of flies, though garbage is hardly left long enough for that, yet the danger is that the odors of garbage attract flies from still more undesirable localities. Garbage cans should, therefore, be odor tight as well as fly tight, and should be water tight, for otherwise leakage from the can will cause accumulation of foul-smelling substances in the soil about it.

We recommend that the garbage cans should be kept in screened places on cement foundations which can be easily taken care of. Cans for the reception of food refuse during the preparation of the meal must be emptied after each meal. All garbage cans must be thoroughly cleansed after emptying and should be carefully sunned.

The final disposal of refuse and garbage is an important problem. Tin cans and such refuse should be cleansed so that no food is left in them, or burned out in an incinerator, then hauled away and buried. Garbage is usually taken away by a farmer to be fed to his pigs, but in some places this cannot be done. Under these conditions it should be burned.

Any method of sewage treatment or excreta disposal, if it is to be effective in the reduction or elimination of disease, must prevent:

(*a*) The access of flies to the excreta.

(*b*) The access of animals to the excreta.

(*c*) The scattering of the excreta or sewage over the surface of the ground, causing soil pollution.

(*d*) Ground water pollution, or the contamination of wells, springs and other sources of drinking water.

There are, of course, other points which must be considered before the workability or practical application of any type of privy or method of excreta disposal can be determined, but the sanitary and health protective values will depend almost entirely upon compliance with the mentioned conditions.

It is not necessary to go into the detail of the first requirement, as it is a well-known fact that flies are carriers of various diseases, and all filth should be protected against the fly so that he will not be scattering filth about. The persons who are actually sick are probably not the only ones infected, as others escape through natural resistance, or immunity, or for other reasons.

The important thing is to select the proper or best methods of sewage disposal which the situation of the camp and the character of the soil demand.

The camp owner has choice of the pit, box, can, concrete vault, chemical and septic privies where running water is not available, and where flush toilets are used the septic tank is the best means for disposal. These for convenience can be divided into two groups, those in which water is not utilized as a flushing or carrying agent and those included in the water-carrying system.

The first class as a whole are not entirely satisfactory, yet have advantages under certain conditions.

The pit or vault privies should be made inaccessible to rats and vermin. Deep, tightly built vaults keep out rats and other animals, but are hard to clean. The pit privy is preferably used in some instances because the house can be moved to new positions and the pits covered with less nuisance than attends cleaning the permanent vaults. The privy house itself should be fly proof.

For the dry earth privy dry earth or other substances are used to cover the excreta. Because of the use of the earth, ashes or other substances, the amount increases rapidly, and necessitates cleaning often.

The box and can or pail system has little to recommend it when other systems are available. The pail, can or box should be cleaned often, and in some cases daily. It is often difficult to get a scavenger to do this, and it means that the excreta are to be disposed of by some method. The person emptying the cans or pails is usually more concerned in doing it the quickest way than in doing it the right way, so he has to be kept constantly under supervision. Various methods are used for this disposal. It may be buried, incinerated or the tank treatment used. The choice of this final disposal will depend on the amount of material to be disposed of, the type of soil and other considerations. Burial is perhaps the method most frequently used where sewers are not available for disposal. The most common disposition by burial is in pits or trenches. These may be of various sizes and depths, but generally they should be not over three or four feet deep and the pits or trenches should have a cover of at least twelve inches of soil.

The main advantages of burial in pits or trenches are less attraction to flies, less nuisance, better covering, and the reduction in the chances for surface wash or mechanical pollution.

In pits used for the whole year in our climate the question of freezing must be taken into consideration, but as camps are only used about two months in the year, we do not have to consider this.

The septic type of closet depends for its action upon the same principal as the septic tank, that is, the retention of the excreta and storage under such conditions as to allow a process of sedimentation and septic action. Water is added to aid in the bacterial action. The overflow from the tank must be treated further to prevent it from spreading disease.

This type of privy was developed by Drs. Lumsden, Roberts and Stiles of the U. S. P. H. S. and at once sprang into much favor. It was, most unfortunately, advertised widely as a type requiring no care. It must be given regular attention or it is very objectionable, especially in the northern States when the freezing cold weather has to be considered for all-the-year use, and is especially objectionable when large numbers are using it, as in the summer camps. Sufficient size is an absolute necessity and the initial cost is quite high.

We have been considering the disposal of excreta by means of the various kinds of privy, but the privy is no longer adequate when running water has been installed in the house, and bath toilet, kitchen sink and other connections are contributing to the wastes from the household. These wastes consist of a mixture of a large amount of water and a small amount of fecal and other organic matter. This relatively small amount of organic and fecal matter is sufficient, however, to render the entire mixture objectionable and subject to putrefaction. The sewage may also contain disease germs. Some treatment must be given to prevent nuisance and the spread of disease.

The most generally used process of primary treatment or clarification is tank treatment. The sewage is passed through a tank or chamber which slows up the velocity of flow sufficiently to cause the coarser suspended matter to settle to the bottom or rise to the top. The partially treated sewage, now called the effluent, passes on out of the tank, to undergo further or secondary treatment if it is deemed necessary. Septic tanks of various construction are most commonly used in the treatment of sewage. Imhoff tanks or plain settling tanks may also be used. The septic tanks treat sewage by sedimentation and septic action.

The size of the septic tank depends upon the amount of water to be used. If shower baths in addition to the regular sewage are to be used the capacity has to be increased, and must also depend on the character of the soil and lay of the land where the final disposal is made.

The cesspool, which is a basin or pit in the earth for the reception of effluent from a water system of sewage disposal, is of two kinds, the leaching and tight. The subsoil in the vicinity becomes heavily polluted, the distance of travel of such pollution depending on the type of soil and the depth of the ground water. The depth is usually great enough to place dangerous contamination within reach of ground water, thus increasing the danger. For this reason cesspools are not considered very favorably.

The various methods of secondary treatment include sub-surface irrigation, sand filters, trickling filters, leaching wells, etc.

The most common is sub-surface irrigation, which consists of discharging the effluent from the tank into the earth beneath the surface of the ground. This is usually accomplished by means of a line of open joint tile laid in one or more rows 12 to 20 inches under the ground surface. The effluent from the septic tanks overflows into the pipe line through the open joints into the ground. This method may be used in any place where the ground is porous enough to absorb the liquid and where there are no conditions tending to cause pollution of ground water. It works best, of course, in a sandy or gravelly soil, and may be used, with proper precautions, in tight soils. The tighter the soil, the greater the amount of tile needed and the more care required in construction.

The kitchen sewage should not go into the same tanks or cesspools into which the toilets empty, as the excessive amounts of water that are there used will have a tendency to overload the ultimate disposal of the tanks or pools. To prevent clogging of the pipes used for kitchen sewage the grease trap is used, and so situated that it is of easy access for cleaning purposes.

The sleeping quarters should be located on high, dry ground, well drained and well exposed to sunlight. If tents are used, they should have individual mosquito netting to protect against the mosquito, and the recreation halls should also be protected. Mosquito bites may become infected, and cause not only discomfort but become a danger to life even.

The communicable disease problem is a very important one to consider when boys and girls from six to eighteen years of age are gathered together from all parts of the United States, and even from other countries, as there have been campers from the West Indies, Mexico, China, Japan and Canada. In most of the camps, if not all, a physician's certificate of good health is necessary. This, of course, lessens the chance of communicable disease, yet in spite of this we have some cases brought to us each year. Prompt reports by the camp owners and prompt action of the health department, with proper quarantine, keep diseases at a minimum.

Two years ago scarlet fever developed in the State Y. M. C. A. Camp. In this camp the buildings accommodate forty to fifty boys, so that special quarantine had to be made for all the boys in the building in which the case appeared. Because of the large number exposed there were several cases in that building, yet no cases developed in the other buildings. If the building had accommodated only four or five probably the cases would have been greatly diminished.

It is very important that a separate building be maintained for an infirmary, where all sick can be looked after, and if a case of communicable disease develops it can be properly isolated.

With the advent of the automobile another problem has entered the field of public health. Touring by automobile has become firmly established in this country. Many people have been able to take vacations and view the country as never before. Our roads are full of people who carry their own camping outfits or are looking for established camp sites. Within two or three years many camping places have been offered to the public with, and in many cases without, proper sanitary arrangements.

Many people camp wherever they may happen to take a fancy, by the banks of streams, rivers, lakes and ponds, and by the roadside, leaving the camp site cluttered and a blot on the surface of the earth. Remnants of food scattered about and their excretions not properly taken care of are breeding places for flies and a menace to the community.

In 1922 the Maine State Department of Health started to make analyses of water supplies of all summer camps, offering this service to camp owners free of charge, and urging them to take advantage of the offer.

In 1924 regulations were passed requiring all public eating and drinking places to have their water supply analyzed by the State Department of Health at least once every year. Public eating places were defined in these regulations, and included all recreational camps, lodging places, camping grounds, etc. The regulations also included screened dining rooms, proper garbage disposal and sewage disposal equipment. All food handlers were required to secure a physician's certificate that they were free from any communicable disease. These rules and regulations were particularly well received by owners of camps, and greatly improved the general character of the camps.

Last winter the Legislature passed a law requiring that all recreational camps, roadside eating and lodging places, overnight camps, etc., must secure a license from the State Department of Health, and in order to secure this license they must comply with all the rules and regulations pertaining to public eating places. This requires an inspection of every camp, and it is hoped that the sanitary conditions of these places will soon be the best that may be secured.

No summer outing is more profitable to the city child than that of the well-conducted summer camp. Six or ten weeks of camp routine, with its schedule of work and play, is apt to make any child more robust, more self-reliant and resourceful, better able to co-operate with others, and a keener lover of outdoor life and nature. But with such quantities of camps to choose from — mountain, lake, forest and grove — how are parents to know which is most desirable?

Since the first aim of the summer camp is to produce healthy youngsters, the wise parent will look into the provisions that are made for insuring good health. In the first place, it is well to make a study of the camp site. More than natural beauty of landscape and bracing air are needed to make the summer camp a safe place for children. Very important is it that the camp have a safe water supply and a sanitary method of waste disposal.

Care should be taken that the camp does not receive its water from polluted streams or unsafe wells. Those in charge of a summer camp have failed in their duty if they have not had an analysis made of the water supply. In most camps, not too remote from civilization, standard sanitary equipment can and should be secured, and installed. This should at all times be kept in good working order, or it may constitute a serious menace to health.

When parents have satisfied themselves that the camp has made ample provision for its sanitation, they should concern themselves with possibilities for contagion. When so many children from various communities and States are gathered into one camp there always is danger of the outbreak of communicable disease. Among a group of children there are almost certain to be carriers, and often actual beginning cases of disease. The well-conducted camp will provide for the examinations of each child during the period of their attendance.

If a child should fall ill there should be provision in the camp for his prompt isolation, and some one with sufficient knowledge of control measures should take the situation in hand.

The better camps will require that before the child is admitted he must be vaccinated against small pox and immunized against typhoid fever. It would be well if the child is also protected against diphtheria.

Most camp leaders make wise requirements as to the amount of warm clothing and bedding that the children must provide; also, they are restricted from taking an excess of such commodities.

These, then, are some of the precautions that parents should take in enrolling their child in a summer camp. What the camp offers in the way of special recreation and education are matters for personal preference. A good thing to do, however, before the child is entered in any camp, is to have a complete physical examination made of him. He might have a weak heart that would not stand strenuous swimming, long hikes, canoe races or other athletic events of the summer camp.

In summary, the sanitation of camps resolves itself into practically three factors:

(1) Proper location.
(2) Safe and adequate water supplies.
(3) Safe and efficient disposal of wastes.

Of General Interest

AN OLD STONE STAIR

Structural Analyses of an Unusual Type of Stair

*By Henry Brask**

During alteration to an old building in Scollay Square a very interesting old stone stair was exposed. The stair is one story in height and composed of blocks of brown sandstone, one block for each riser. One end of these blocks is imbedded 8 inches in a brick wall and the other end entirely unsupported except for the lower 4 blocks. These 4 blocks are carried by the wall at one end and a brick pier at the other. The blocks are well fitted at points of contact and there is no indication whatever of any settlement or distress in either the stair itself or in the brick wall.

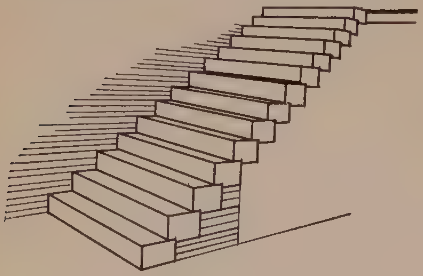

Fig 1.—Perspective of Stair

Since an 8-inch imbedment would be inadequate for cantilever action it was at first thought necessary to add a supporting wall under the free end of the upper blocks, but analysis and test showed the stair to be perfectly stable, so it was left in its original condition.

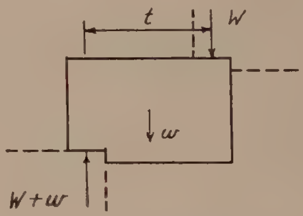

Fig. 2.—Forces acting on Any One Block

The blocks do not cantilever from the wall. The wall merely keeps the blocks from rotating. Fig. 2 indicates the forces acting on any one block. W = the total load coming on any one block from those above, w = weight of one block plus live load.

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* With Burtis Brown, Consulting Engineer, 65 Franklin Street, Boston.

There is a twisting moment in each block equal to $Wt+\frac{wt}{2}$. The twisting is resisted by the strength of the block in torsion and by the brick wall at one end.

Calculation of extreme bearing stress in brick wall due to twisting in tenth block from top: —

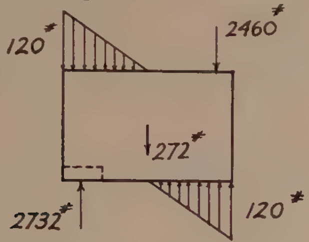

FIG. 3. — LOADING DIAGRAM

$$\text{Live load} = 75 \times .85 \text{ (on one block)} = 63.7$$
$$\text{Dead load} = 1.1 \times .6 \times 140 = 92.3$$
$$\text{lbs. per ft. (one block) } 156.0$$
$$W = 156 \times \frac{3.5}{2} \times 9 = 2460$$
$$w = 156 \times \frac{3.5}{2} = 272$$
$$W + w = 2732$$
$$M = (2460 \times 10\tfrac{1}{2}) + (272 \times 5\tfrac{1}{4}) = 27200$$
$$f_b = \frac{27200 \times 2}{8.67 \times 52} = 120 \text{ lbs. per sq. in.}$$

This figure (120) is well within the allowable for both the brick and the sandstone. Any stair of this type must be anchored in a solid wall in sound condition in order to be safe. The wall must also be of sufficient height to safely resist the twisting action of the blocks.

Bridge Built by Blacksmith

Mr. Earl H. Chase of Fairhaven, Massachusetts, has "discovered" an old bridge spanning the Black River near Drummondville, Quebec, which is said to be one of several built by a blacksmith. It is in regular use and in pretty fair condition at present. Although the age of the bridge is not known, we should judge by its style that it might have been built as far back as 1870.

Its main members are railroad rails. These, together with flat bars for diagonals, round rods for horizontal bracing and a few pounds of castings, constitute the entire metal work in the bridge. The floor system is timber. There are no guard rails.

Fig. 1 is a drawing made from field measurements by Mr. Chase.

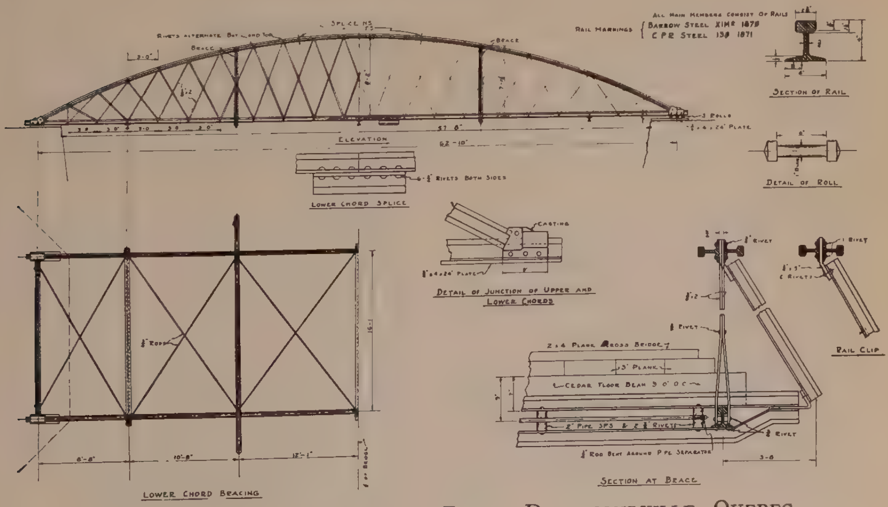

FIG. 1. — BRIDGE OVER BLACK RIVER, DRUMMONDVILLE, QUEBEC

PROCEEDINGS OF THE SOCIETY

MINUTES OF MEETINGS

Northeastern University Section

A meeting of the Northeastern University Section of the Boston Society of Civil Engineering was held February 8, 1929, at 7.30 P.M., in Room 26 in the Huntington Building, with H. L. Burton presiding.

The minutes of the previous meeting were accepted as read.

The speaker of the evening was Mr. W. A. Hogue, engineer for the Warren Brothers Company, Cambridge, who talked on the subject "Bituminous Pavements."

Mr. Hogue outlined the history of the Warren Brothers and described to some extent the experiments which led to the development of the present type of bituminous pavement. He also described the various cross sections of pavements, explaining in some detail the advantages and disadvantages of concrete base over what is known as black base.

Mr. Hogue also emphasized the fact that good drainage is a major consideration in good road design.

The talk was illustrated by slides and a reel of moving pictures.

Following a short discussion the members had dinner at the Café de Paris.

H. L. BURTON, *Clerk pro tem.*

APPLICATIONS FOR MEMBERSHIP

[February 20, 1929]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of fifteen (15) days from the date given.

For Admission

BERNAT, GEORGE A., Jamaica Plain, Mass. (Age 24, b. Boston, Mass.) Attended Tufts Engineering School one year, 1923–24. Graduated from Massachusetts Institute of Technology in 1928. Since then has been employed by Mark Linenthal, Engineer, as steel and concrete designer. Refers to *K. R. Garland, W. H. Lawrence, Mark Linenthal, Dean Peabody, Jr.*

BURAK, TERRANCE MATHEW, Brookline, Mass. (Age 20, b. Yonkers, N. Y.) Student at Northeastern University. Refers to *W. J. Alcott, H. B. Alvord, C. O. Baird, J. W. Ingalls, W. E. Nightingale.*

CAMPOBASSO, JOHN J., Arlington, Mass. (Age 23, b. Arlington, Mass.) Spent one year at Tufts, then entered Massachusetts Institute of Technology and graduated in 1928. Is now doing field work and inspection on construction of Third River sewer in Bloomfield, N. J., for Metcalf & Eddy. Refers to *J. B. Babcock, H. P. Eddy, Jr., C. M. Spofford.*

CANZANELLI, ANDREW, Arlington, Mass. (Age 34, b. New York City.) Entered

University of Pennsylvania in 1915 and transferred to Massachusetts Institute of Technology in 1916; left Technology in 1917 to accept a position as surveyor with a western mining company. Entered military service in 1918 and served until January, 1919; 1919–20, employed as erecting mechanic; returned to Technology, 1920–22, but in 1923 accepted a position as civil engineer in the Metropolitan District Commission under the late John R. Rablin. Is now assistant civil engineer in Park Division. Refers to *D. A. Ambrose, J. B. Babcock, W. H. Cronin, V. J. Grande, L. E. Moore.*

Harding, John Henry, Boston, Mass. (Age 24, b. Boston, Mass.) Graduate of Massachusetts Institute of Technology in 1927, with degree of B.S. in civil engineering. Transitman on land subdivision at Lucerne under Prof. C. B. Breed from June to September, 1926; draftsman and transitman with Arnold G. Carey, Medford, on land subdivision and general city survey work from November, 1926, to July, 1927; draftsman, instrumentman and chief of party on Head Pond flowage survey, Grand Falls Power development for St. John River Power Company, at Van Buren, Me.; worked under A. H. Rheinlander from November, 1927, to October, 1928. Refers to *J. B. Babcock, H. K. Barrows, J. W. Howard, W. A. Liddell.*

Magnuson, Carl Alden, Arlington, Mass. (Age 21, b. Everett, Mass.) He is a student at Northeastern University and during the co-operative periods has been employed by Aspinwall & Lincoln since September, 1927, to date. Refers to *W. J. Alcott, C. O. Baird, W. E. Nightingale, C. A. Wolfrum.*

Mason, Frank Henry, Augusta, Me. (Age 50, b. East Somerville, Mass.) With Hudson River Water Power Company as assistant engineer for five years; Bar Harbor & Union River Power Company as assistant engineer nine months; Central Main Power Company, chief engineer, seventeen years; now chief engineer, New England Power Service Company, Augusta, Me. Refers to *H. K. Barrows, A. C. Eaton, S. S. Kent, A. T. Safford.*

Rice, George Emerson, Chelsea, Mass. (Age, 20, b. Chelsea, Mass.) Entered Northeastern University in the fall of 1926. During co-operative periods was employed by the city of Newton, engineering department, thirty-two weeks of his sophomore year; is still employed here as transitman. Refers to *W. J. Alcott, H. B. Alvord, C. O. Baird, J. W. Ingalls.*

Roberts, Albert Arthur, Winchester, Mass. (Age 25, b. Wilmington, Mass.) Graduated from Parsonsfield Seminary, Parsonsfield, Me., in 1922. Came to Boston in fall of same year and entered the employ of Edison Electric Illuminating Company, and was in their employ until he entered Northeastern University. During the whole of the co-operative periods has been employed by Henry F. Bryant of Brookline. Refers to *W. J. Alcott, H. B. Alvord, H. F. Bryant, W. A. Bryant.*

Sayre, Daniel, Boston, Mass. (Age 26, b. Columbus, Ohio.) Graduate of Massachusetts Institute of Technology, with degree of B.S. in civil engineering. Spent six months on the O'Shaughnessy Dam and six months on the Wilson Dam, Muscle Shoals. Connected with Boston Airport Corporation from 1925–28; was half-time instructor in Department of Aeronautics at Technology, 1927–28, and this year is a full-time instructor. Refers to *J. B. Babcock, J. C. Nowell, C. M. Spofford, Hale Sutherland.*

Smith, Myron Howe, Boston, Mass. (Age 30, b. Philadelphia, Pa.) Graduate of Amherst College, with degree of A.B. in science. From October, 1921, to April, 1922, was technical control assistant for R. B. Wolfe & Co. in Lisbon Falls Mill (Maine); from May, 1922, to June, 1926, was engaged in telephone engineering with Western Electric and Bell Telephone, with experience in transmission problems and in design; from June, 1926, to April, 1927, was engaged in a supervisory and operating capacity in the main office of the General Engineering and Management Corporation; from May, 1927, to November, 1928, engaged in appraisal work with Jackson & Moreland; since November, 1928, assistant engineer for the New England Power Construction Company of Boston. Refers to *C. R. Bliss, E. H. Cameron, F. M. Carhart, W. D. Henderson, D. C. Jackson.*

NEW MEMBERS

Members

John R. Carroll, Norway Place, Pittsfield, Mass.
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Charles K. Brown, 10 Huntington Avenue, Amesbury, Mass.
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Joseph A. C. Komich, 548 Fourth Street, South Boston, Mass.
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DEATHS

Fred B. Forbes . . .	Jan. 26, 1929
Frank H. Mills . .	Feb. 2, 1929

BOOK REVIEW

"American Sewerage Practice": Vol. I, Design of Sewers, by Leonard Metcalf and Harrison P. Eddy, New York and London: McGraw-Hill Book Company, Inc. Second Edition. Cloth 6 x 9 in.; pp. 759; 305 line cuts and half tones; 167 tables. $7.[*]

This second edition of the first volume of the well-known trilogy of "American Sewerage Practice" will be greeted by engineers with even more interest and appreciation than was its predecessor a decade and a half ago. It is only natural that this should be so; one prefers to hear the news from a tried and trusted friend rather than from a new acquaintance.

We are told in the Preface to this new edition that during the years between "American practice in sewer design has attained a greater degree of uniformity, considerable advance has been made in the methods of application of principles, and there has been material increase in the amount of pertinent information available." Let us see what changes and additions these developments have necessitated in the "Design of Sewers."

Aside from bringing statistical material up to date, adding illustrations and descriptions of newer equipment and works, and rearranging certain sections of the book to present matters in somewhat better sequence, we note especially the following:

There is added to Chapter II, on the flow of water and sewage, a section on non-uniform flow, including draw-down, back-water and the hydraulic pump. Newer flow formulas are discussed, together with losses of head from causes other than friction. A diagram for the solution of general problems involving Kutter's formula is presented.

Discussion of the measurement of water, treated in Chapter IV, is made to include the more recent weir formulas, the newer measuring devices, such as flow meters and Venturi flumes, and the use of dyes and chemicals. Chapter V, on the quantity of sewage, is thoroughly modernized, and presents new information on the economic period of design, effect of zoning, and relation between average and maximum rates of flow.

A new chapter on separate sewers (Chapter VI) has been added and carries the engineer through the various steps of design; the principles used are well exemplified. Attention is called to the analysis of minimum-flow conditions, a subject too often regarded as an unavoidable evil rather than as a necessary feature of design.

Chapter VII, as revised, deals with precipitation in an admirable fashion, illustrating the development of rainfall curves from original observations and the best approach to formulation of time-intensity relationships. In line with this treatment is the greater elaboration in the new edition of the rational method of storm-sewer design (Chapter VIII). The zone principle or time contour analysis of run-off is presented. Discussion of empirical methods is rightly curtailed.

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[*] Reviewed by Gordon M. Fair, Assistant Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

Chapter XI gives new information on sewer pipes, especially as regards external loading. This factor is supplemented by a new analysis in Chapter XII, on the loads that sewers may have to carry under special circumstances. New material in Chapter XIV, on the analysis of stresses in sewer sections, greatly facilitates the understanding and solution of masonry-sewer design.

An example of determining upon the hydraulic characteristics of an inverted siphon is added to Chapter XVI, which treats of junctions, siphons, bridges and flushing devices. Discussion, in Chapter XVII, of the work of Engels, Coleman and Smith, and Babbitt on side weirs, replaces that of Parmley's studies. Siphon relief structures and other new methods of diverting or controlling sewage flow are also treated. Chapter XVIII, on pumps and pumping machinery, has been brought up to date.

The chapters not specifically mentioned by the reviewer have been held substantially the same as in the first edition. The index is excellent, adding greatly to the value of the book for reference purposes.

One of the authors, Mr. Metcalf, died in January, 1926. The responsibility for the revision, therefore, devolved upon Mr. Eddy, who, in the Preface, acknowledges the engery and enthusiasm devoted by Mr. Metcalf to the preparation of the first edition and to the work of revision, which was begun several years before Mr. Metcalf's death. Acknowledgment is also made of the assistance of Mr. Eddy's partners and staff, as well as of others.

It seems to the reviewer that, throughout the book, the selection of new material has been a very happy one. The general rearrangement of the subject matter is also to be commended. The revision fully measures up to the high standard of the original work, and sanitary engineers in America may continue to point with pride to "American Sewerage Practice" as a twentieth century classic of their profession.

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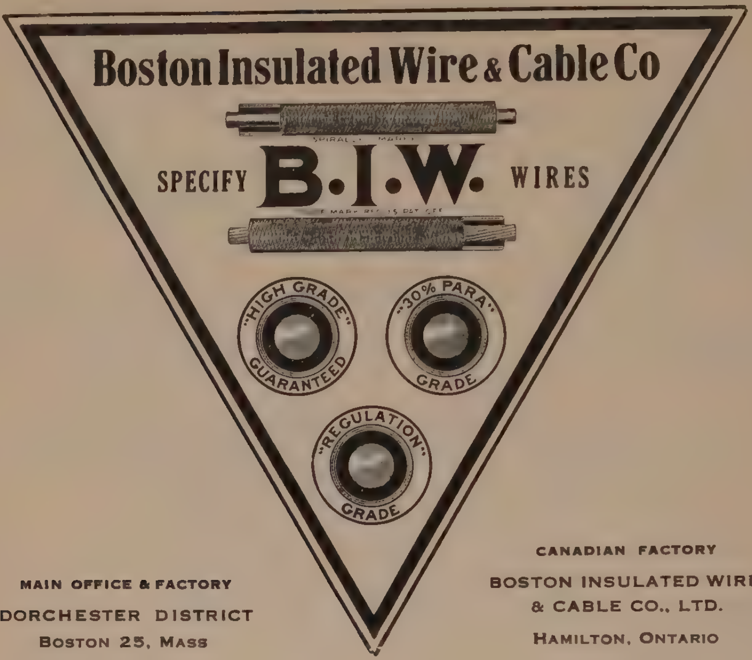

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